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STATISTICAL BULLETIN
Metropolitan Life Insurance Co.

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A HISTORICAL RETROSPECT ON EXPECTATION OF LIFE

The Statistical Bureau of this Company receives so many inquiries regarding the trend of the expectation of life (mean length of life) in both the recent and more remote past that we may infer this to be a subject of considerable public interest. We have, therefore, decided to publish herein a synopsis of some of the principal data available on this subject.

Many of the inquiries call for information regarding the increase in the length of life in the last fifty or a hundred years. Now the extreme span of life has probably changed very little in historical times. There have always been *some* men who lived to a great age, eighty, ninety years, and an occasional century. What has changed very materially is the *proportion* of all the persons born who attain higher ages, and, contrariwise, the proportion that die in adolescence and infancy. The customary measure of the longevity characteristic of different times and places is the *average length of life*, as computed for a group or cohort of 100,000 persons who start out upon life together and are diminished in numbers gradually by deaths, in accordance with the observed rates of mortality. Instead of considering a cohort of 100,000 persons starting out on life together, it is often convenient to fix our attention upon 100,000 persons of a given age, as for example age 40, and to compute their average after-lifetime. According to the 1920 United States Life Table, for example, this comes out as 29.6 years for white males forty years old; meaning that, on an average, white men forty years of age will live 29.6 years longer, or reach age 69.6, according to mortality conditions of 1920. Or, in other words, a man forty years of age may reasonably *expect* to live 29.6 years more. This is commonly expressed by saying that his *expectation of life* at age forty is 29.6 years. The expectation of life at a given age is the same thing as the *mean after-lifetime* or the average number of years lived after

attaining that age; and the expectation of life *at birth* is evidently the same thing as the mean or average length of life. If the words *expectation of life* are used without specifying any particular age, it is commonly understood that the expectation of life *at birth* is meant, that is, the average total length of life.

But to return to our main topic, namely, the increase in the length of life in past decades. It should be remarked, first of all, that the preparation of official life tables relating to any large section of the United States is a comparatively recent institution; the first life table of this kind, based on the mortality figures for the ten states which first practiced regular official registration of deaths (the so-called *"Original Registration States"*) relates to the first year of the present century, 1901. Similar life tables have been issued by the Census Bureau relating to the years 1910 and 1919–1920. This last table shows an expectation of life, at birth, of 55.33 years for white males, and 57.52 years for white females.

The State of Massachusetts has been particularly progressive in matters of vital statistics. The regular series of life tables for this state dates back ten years earlier than the first table of the Federal series, *i.e.*, it represents the mortality of 1890. But there are some isolated life tables reaching further back than this and here again Massachusetts is in the lead, with the WIGGLESWORTH life table published in 1789, on the basis of mortality statistics gathered in certain parishes of the States of Massachusetts and New Hampshire. This table showed an expectation of life at birth of 28.1 years. But the method by which it was constructed is faulty and gives too low a figure. WIGGLESWORTH, himself, was aware of this and suggested a correction by which the expectation of life at birth would be raised from 28.1 to 35.5 years.

The earliest of all life tables (except one or two very primitive efforts in the Third Century) is one for the City of Breslau, Germany, prepared by HALLEY and relating to the year 1693. This gives the expectation of life at birth as 33.5 years. A number of other early life tables of historical interest will be found listed in the accompanying table which shows the corresponding expectation of life at birth. The table also presents modern American and English data.

Quite naturally, in such a historical review as has been presented of the principal American and English figures for the expectation of life, the question arises: What have been the gains achieved in past years? An exact answer, applying to the entire period of the records, cannot be given, partly because of the uncertainty of the data, but

more particularly because the areas to which they apply differ from case to case. For this reason only a roughly approximate statement can be made, especially where the earlier figures are involved. Making due allowance for this we may say, in round numbers, that in the 120 years from 1800 to 1920 there has been, in the United States, a gain of some twenty-five years in the expectation of life. It is pleasing to observe that the last two deeades for which we have official data, namely, from 1900 to 1920, show relatively greater gains than the earlier periods. From 1900 to 1920 the Original Registration States show a gain of more than five years for white persons; that is, a rate of gain of over two and one-half years per decade. In contrast with this, if we adopt the figure of about 40 years as about representative of the expectation of life in 1850 (being guided in this by the data shown for Massachusetts and Maryland) we see that for the half century from 1850 to 1900 there was a gain of only about eight years, that is, a gain at a rate of only about one and a half years per decade. Moreover, judging by the figures for Massachusetts, 1878-1882, it is seen that most of the gain between 1850 and 1900 took place during the last two decades of the century. While this contrast in favor of the most recent years is very gratifying, it may be well to remind our readers of a point to which we drew attention recently; namely, that it will no doubt become increasingly difficult to add further to the expectation of life, as we approach the limits of what can reasonably be expected with human possibilities. Perhaps we are beginning to feel now the operation of the law of diminishing returns; for the last year or two have not shown material gains in expectation of life. It is not necessary here to rehearse once more our remarks regarding this point. Only this should be added, to prevent misunderstanding: that a slight set-back in any one particular year is in itself of no great significance, since fluctuations up and down must necessarily be expected. Furthermore, all indications are that the present year will be a record health year and accordingly show a high figure for the expectation of life.

So far we have reviewed only expectation of life at birth, or mean length of life. A complete historical discussion of the expectation of life at all ages would lead us beyond the scope of an article adapted for these pages. But to one question, which is often asked, it is appropriate to give attention here, namely, as to the ages of life at which the gains have mainly taken place. It is a matter of common knowledge that the chief gain has taken place through the

saving of infant and child lives. It is sometimes stated that there has been no gain in adult life, or even that there has been a loss. This, however, overstates the case. In the decade 1910–1920 the only part of life at which the life tables show a decrease in expectation of life, for the Original Registration States, is age 83 and over for males, and age 92 and over for females. Only for the previous decade, 1900-1910, do the figures show slight decreases in the expectation of life over an extended age period, from age 32 to the end of life for males, and from age 47 to the end of life for females. Whatever occasion there may have been, at that time, for solicitude, seems to be eliminated in the present state of affairs.

Extracts from Some Historical Life Tables

Authority	Territory	Date	Expectation of Life at Birth in Years		
			Males	Females	Persons
Halley	Breslau (Germany)	1687–169	——	——	33.5
Price	Northampton (England)	1735–1780	——	——	30.0
Milne	Carlisle (England)	1779–1787	——	——	38.7
Wigglesworth	Massachusetts and New Hampshire	1789	——	——	35.5
Pennsylvania Company for Assurance Upon Lives	Philadelphia	1814	——	——	26.0
Pennsylvania Company for Assurance Upon Lives	Episcopal Church, U. S.	1814	——	——	31.0
Official English Life Table No. 1	England and Wales	1841	40.2	42.2	——
Kennedy	Massachusetts	1850	38.3	40.5	——
Kennedy	Maryland	1850	41.8	44.9	——
Elliott	Massachusetts	1855	——	——	39.8
Meech	United States, White	1860	41.01	——	——
Billings	Massachusetts	1878–1882	41.74	43.50	——
U. S. Life Tables (Glover)	Massachusetts	1890	42.50	44.46	——
Abbott	Massachusetts	1893–1897	44.09	46.61	——
U. S. Life Tables (Glover)	Massachusetts	1901	46.07	49.42	——
U. S. Life Tables (Glover)	Massachusetts	1910	49.33	53.06	——
U. S. Life Tables (Glover)	United States Original Registration States, White	1901	48.23	51.08	——
U. S. Life Tables (Glover)	United States Original Registration States, White	1909–1911	50.23	53.62	——
U. S. Life Tables (Glover)	United States Original Registration States, White	1919–1920	54.05	56.41	——
U. S. Life Tables (Glover)	United States Registration States, White	1919–1920	55.33	57.52	——
Official English Life Tables No. 3	England and Wales	1838–1854	39.91	41.85	——
No. 4	England and Wales	1871–1880	41.35	44.62	——
No. 5	England and Wales	1881–1890	43.66	47.18	45.39
No. 6	England and Wales	1891–1900	44.13	47.77	45.92
No. 7	England and Wales	1906	48.53	52.38	——
No. 8	England and Wales	1911	51.50	55.35	——
No. 9	England and Wales	1921	55.62	59.58	——

THE DIPHTHERIA DEATHRATE IN 1927

Reports from various parts of the world indicate a marked increase in the prevalence of diphtheria this year. The increase seems also to have been quite general over the United States. With the exception of the West North Central and the Mountain States, all of the broad geographic divisions showed increased diphtheria prevalence in 1927 as compared with similar periods in 1926. In thirty-five of our States, 45,165 cases were reported during the first six months of this year. In the same area, for corresponding months in 1926, 33,684 cases were reported. Furthermore, in certain cities the increased prevalence was not limited to certain localized areas, nor were any particular factors such as milk, food or epidemic foci identified. In Chicago there was an increase of 50 per cent. in cases and of 100 per cent. in deaths during the first seven months of 1927 as compared with the same period in 1926. The case-fatality rate of Chicago cases was 10.1 per cent. in 1927 and 8.8 per cent. in 1926.

Increased case-fatality was not a general phenomenon this year, however. For nearly 23,000 cases reported in cities having more than 400,000 population, the United States Public Health Service found a case-fatality rate of 6.4 per cent. in 1927. In 1926, the case-fatality rate in these cities was 7.6 per cent.

From 1921 to 1926, the diphtheria case and deathrates (reckoned against population) have declined precipitately. In our STATISTICAL BULLETIN for December, 1924, we pointed out that the deathrate from diphtheria had declined between 1905 and 1918 at a rate of 2.8 per cent. per year, but that beginning with 1918 and continuing through the new toxin-antitoxin era, a renewed downward trend set in, at a greater rate of decline per year. The toxin-antitoxin period, say the last seven years, has been characterized by this rapid fall in case and deathrates, and by no return of the former sharp tendency toward an outbreak every three or four years.

The full period between major outbreaks in past years for diphtheria seems to have been about seven years*, with a half period every three or four years. The last year of a high diphtheria deathrate was 1921. With the elimination of the three or four year half-period, some evidence of the seven-year major point might be looked for in 1928. The recent increase in diphtheria case and death incidence may possibly be viewed as the premature appearance of this expected seven-year periodic outbreak. On the other hand, since no cause for the 1927 increase in the disease can be found in relaxed sanitary supervision,

*STATISTICAL BULLETIN, September, 1926, page 4.

in a diminished administration of toxin-antitoxin, or in fulmination from foci of unusual character, may we not have gone through a wave of diphtheria which was the result of weather influence upon both host and invading organism? Were the old epidemiologists right when they associated cold, wet weather with severe outbreaks of the disease? An inquiry into this aspect of diphtheria, relating departures of the diphtheria deathrate from its "norm," to departures of weather elements from their "expected" performance may yield information of real value.

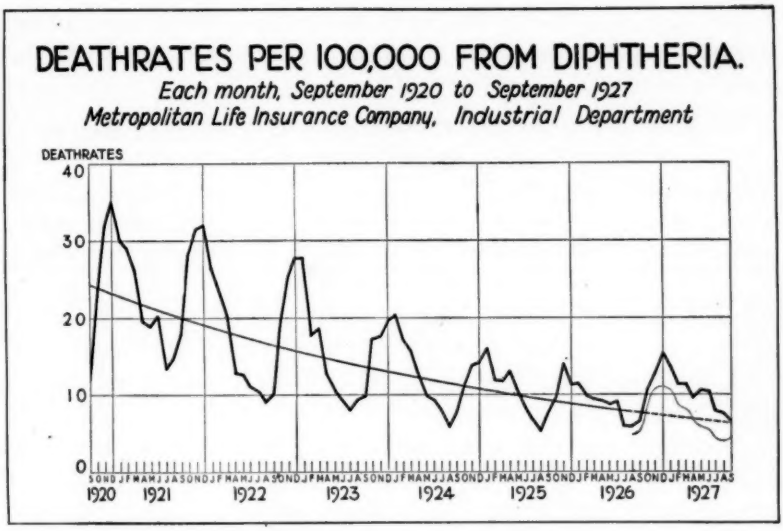
The facts on diphtheria mortality among Industrial policyholders of the Metropolitan Life Insurance Company for each of the "waves" of the disease since 1920 are shown in the following table. The monthly figures, with trend line from 1920 to 1927, are illustrated in the graph on page 7.

Diphtheria Deathrates per 100,000 Population
Each Annual Wave, 1920 to 1927
Metropolitan Life Insurance Company,
Industrial Department

PERIOD	DEATHRATE FOR SPECIFIED PERIOD
September, 1926, to September, 1927	10.3
September, 1925, to August, 1926	9.3
September, 1924, to August, 1925	10.9
August, 1923, to August, 1924	13.2
September, 1922, to July, 1923	17.0
August, 1921, to August, 1922	19.2
September, 1920, to July, 1921	23.5

For the 1926-1927 period we have shown against the actual figures on the graph the "expected mortality" which would have occurred if the downward trend had continued in 1927, and if the mean seasonal distribution of mortality in the 1920-1926 experience had occurred in this most recent "wave." The mortality rate of the 1926-1927 "wave" was 10.3 deaths per 100,000 over the period September, 1926-September, 1927 and this was 48 per cent. in excess of the expected. The area between the dotted and solid lines in the 1926-1927 "wave" represents the excess mortality.

It would be helpful, now that the 1926-1927 invasion is over, to have analytical studies of the case-incidence and case-fatality data prepared by statistical offices, taking into account the several factors of sex, age and month of the year. Such facts may throw light on a phenomenon unexpected upon any of the usual grounds.



POLIOMYELITIS IN 1927

The unusual prevalence of poliomyelitis this year has resulted in a deathrate among Metropolitan Industrial policyholders which will exceed that of any year since 1916. For the first ten months of 1927 there occurred 1.9 deaths from this disease per 100,000 policyholders. When the outbreak subsides with the advent of colder weather, the figure may be even higher than that recorded for the year so far.

For the year 1927, through the week ended October twenty-second, 7,544 cases were reported in 47 of our States. This may be compared with a total of 2,754 cases which occurred in these States during the whole of 1926. The States chiefly affected by the recent outbreak are shown in the table on page 8.

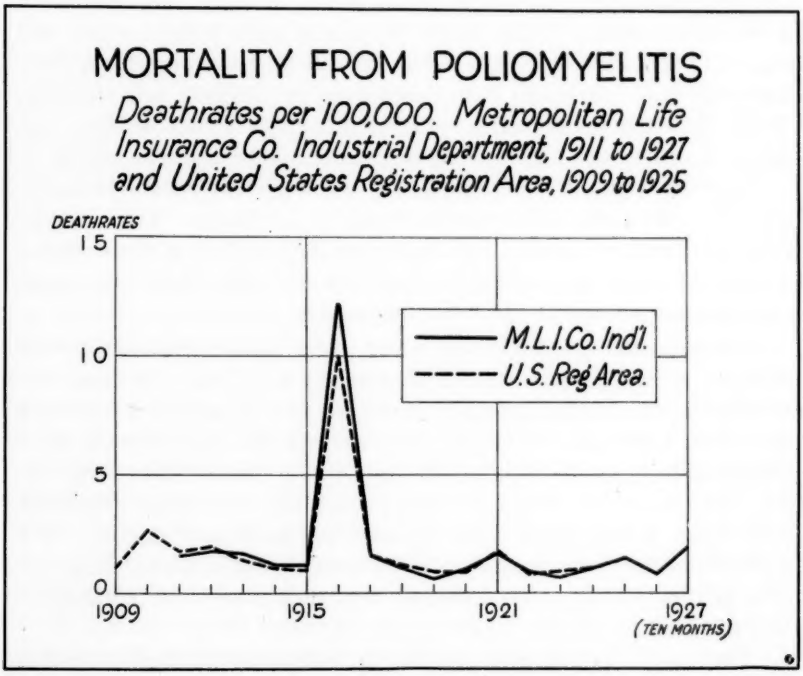
The reported case-incidence seems to have been highest for New Mexico, Massachusetts, California, Oregon and Ohio. In Ohio, the increase in the number of cases during August prompted a call for a state-wide conference of health commissioners in order to work out a concerted programme of attack on the disease. In no State, however, was there the same extensive outbreak such as occurred in 1916, when more than 30,000 cases were reported in the United States. The epidemic in that year seemed to be centered chiefly in the northeastern area of the country, New England reporting more than 3,300 cases and the Middle Atlantic States nearly 20,000.

The course of the poliomyelitis deathrate in the United States

Registration Area since 1909, and in the Industrial Department of the Metropolitan Life Insurance Company since 1911, is shown in the chart below.

Number of Poliomyelitis Cases Reported in Specified States 1927 Through Week Ended October 22d

STATE	NUMBER OF CASES	CASES PER 100,000 POPULATION
California	913	24.9
Connecticut	164	12.1
Illinois	396	6.6
Kansas	171	11.3
Massachusetts	913	26.0
Michigan	213	5.7
Missouri	176	6.1
New Jersey	304	9.8
New Mexico	179	55.2
New York	742	7.9
Ohio	950	17.1
Oklahoma	143	7.3
Oregon	180	24.5
Pennsylvania	367	4.6



HEALTH RECORD FOR OCTOBER, 1927

The remarkably low deathrate in October is one more favorable item in the unprecedentedly good health situation that has prevailed in the United States and Canada during 1927. The deathrate among more than eighteen million Metropolitan Industrial policyholders was only 7.7 per 1,000. This is not only the lowest mortality for any month of the current year among this important cross-section of the population of the two countries, but is actually the lowest figure ever recorded during the month of October for this group of insured people. The above figure may be compared with 8.0 and 8.1 in the same month of 1926 and 1925 respectively. The former minimal rate for this month was 7.9 per 1,000 in 1921. During the ten elapsed months of the current year the deathrate has exceeded that for the corresponding month of 1926 in only a single instance and then very slightly.

The October record for the individual causes of death shows a number of very favorable items. The typhoid fever deathrate, for example, was only 3.7 per 100,000—an extremely low figure for an autumn month, as autumn is the season when, almost invariably, the highest mortality from typhoid is experienced. Last year, for example, the October typhoid fever deathrate was 6.3, and in 1925 it was 7.1. The highest typhoid rates in 1927 were recorded in the spring, due almost altogether to an extremely bad outbreak in Montreal and environs which took a death toll of more than five hundred lives. With the subsidence of the Montreal epidemic, improvement is again being shown in the typhoid deathrate and this is taking place at the very season of the year when the mortality from this disease ordinarily reaches its maximum.

The diphtheria situation has now improved materially. During each of the first eight months, January to August, the diphtheria deathrate compared unfavorably with 1926. In September the rate was identical for each year; but in October, 1927, a figure of 9.6 per 100,000 was recorded as compared with 10.6 in 1926. Each of the four principal epidemic diseases of childhood registered lower mortality than in October a year ago. The October tuberculosis deathrate was 74.7 per 100,000 as compared with 79.3 in 1926. Every month of the current year, with a single exception, has shown improvement in mortality from tuberculosis, and a new minimal figure for this disease is now assured for 1927. Influenza, pneumonia, diarrheal complaints and Bright's disease are the other important causes of death to show lower rates in October than were in evidence a year ago. The mortal-

ity from cancer, diabetes, cerebral hemorrhage and heart disease increased—slightly in each instance.

As has been the case throughout 1927, the record for violent deaths, in October, compares unfavorably with 1926. The suicide deathrate, it is true, was a little lower but those for homicides, accidents and automobile fatalities increased.

The general deathrate for the large cities of the United States in October was 11.3 per 1,000. This was slightly lower than the rate for October, 1926 (11.5) but somewhat higher than the figure for September, 1927. Case reports received from practically all sections of the United States show that during four weeks of October there was increased incidence of diphtheria, influenza, measles, poliomyelitis, scarlet fever and smallpox, as compared with September. There were fewer cases of typhoid fever. Comparison with conditions prevailing last year shows increased sickness from diphtheria, poliomyelitis and smallpox but fewer cases of influenza, measles, scarlet fever and typhoid fever.

Case reports of diphtheria from forty states show an increase to 8,137 in October from 4,936 in September. The most notable increases were in Indiana, Mississippi and New York, exclusive of New York City. Clinics for diphtheria prevention were opened in Detroit on October 24th. In Lowville, New York, with a population of less than 3,500, between 400 and 500 children were immunized against this disease in October. Despite the increase in cases throughout the Country, the diphtheria deathrate, as noted in a foregoing paragraph, was lower than in October of last year.

Measles increased in forty-one states from 2,459 cases in September to 4,179 in October. The latter figure, nevertheless, marks a decrease from 6,139 during the corresponding period in 1926. The most notable increases in measles case reports in October, as compared with September, were in Massachusetts, New Mexico and Pennsylvania. Reported cases of scarlet fever were considerably more numerous in October, more especially in Missouri and North Carolina.

Reports from forty States show a slight increase in the prevalence of poliomyelitis in October as compared with September. In Massachusetts the cases increased from 258 to 371.

Smallpox was a little more prevalent in October, more especially in Oregon and Tennessee. An outbreak was reported from Ottawa, Ontario, and a press report states that ten cases were discovered in a single school at Portland, Oregon. In Norton, a small West Virginia

town, the schools were closed during the first week of October owing to an outbreak of five cases of smallpox.

The following table shows the mortality among the Industrial policyholders for October, 1927, September, 1927, October, 1926, and the year 1926.

METROPOLITAN LIFE INSURANCE COMPANY

Deathrates* per 100,000 for Principal Causes, Premium-paying Business in Industrial Department (Annual Basis)

MONTHS OF OCTOBER, 1927; SEPTEMBER, 1927, AND OF OCTOBER, 1926

CAUSES OF DEATH	RATE PER 100,000 LIVES EXPOSED*			
	Oct. 1927	Sept. 1927	Oct. 1926	Year 1926
TOTAL—ALL CAUSES	769.7	801.4	797.7	945.6
Typhoid fever	3.7	5.2	6.3	4.2
Measles	.4	.5	1.3	10.2
Scarlet fever	1.5	1.6	2.1	3.4
Whooping cough	4.1	6.4	6.1	9.6
Diphtheria	9.6	6.6	10.6	9.7
Influenza	6.5	5.2	7.0	31.1
Tuberculosis (All forms)	74.7	80.7	79.3	99.0
Tuberculosis of resp'y system	66.5	70.3	69.9	86.7
Cancer	71.6	72.7	70.7	73.7
Diabetes mellitus	15.0	14.3	14.1	16.7
Cerebral hemorrhage	49.0	49.9	47.1	55.6
Organic diseases of heart	112.0	114.8	108.3	134.3
Pneumonia (All forms)	46.3	37.3	49.4	98.2
Other respiratory diseases	12.6	12.8	11.2	13.0
Diarrhea and enteritis	36.6	47.0	50.0	29.8
Bright's disease (Chronic nephritis)	60.5	62.8	63.0	73.5
Puerperal state	12.6	12.5	12.0	15.3
Suicides	7.4	8.0	8.0	7.7
Homicides	6.8	5.3	6.4	7.0
Other external causes (excluding suicides and homicides)	62.4	68.2	58.9	62.3
Traumatism by automobiles	20.3	22.2	19.8	16.8
All other causes	176.4	189.7	185.8	191.0

*All figures include infants insured under one year of age.

Correspondence on the subjects discussed in these BULLETINS may be addressed to: The Editor,

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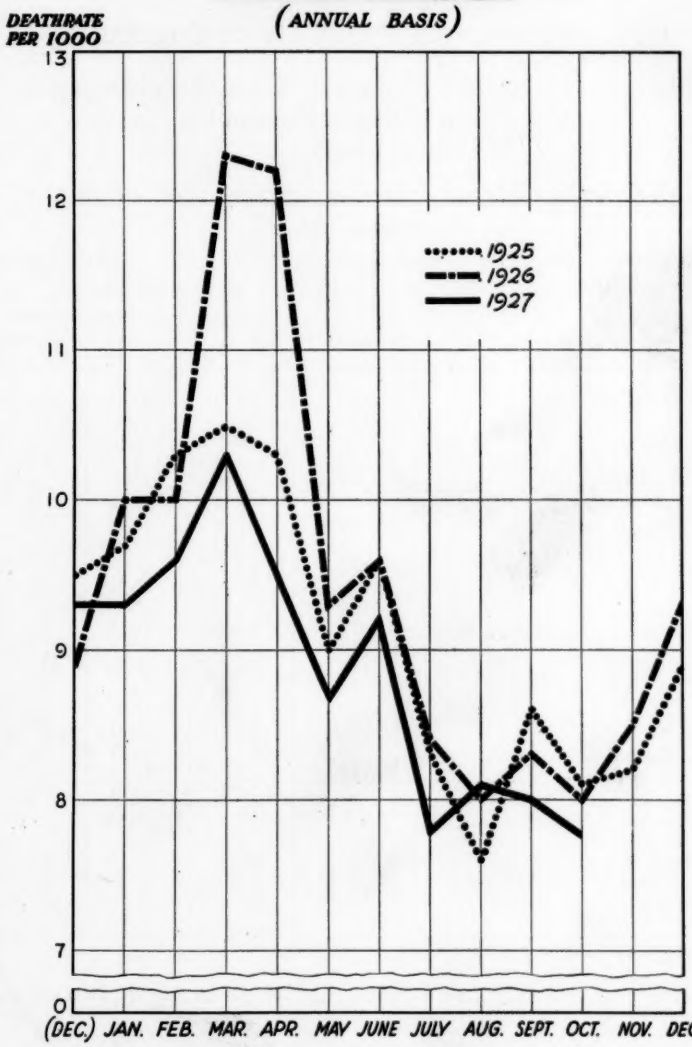
Deathrates from All Causes

METROPOLITAN LIFE INSURANCE CO.
INDUSTRIAL DEPARTMENT
(ANNUAL BASIS)



	(DEC.)	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1925		9.7	10.3	10.5	10.3	9.0	9.6	8.3	7.6	8.6	8.1	8.2	8.9
1926		10.0	10.0	12.3	12.2	9.3	9.6	8.4	8.0	8.3	8.0	8.5	9.3
1927		9.3	9.6	10.3	9.5	8.7	9.2	7.8	8.1	8.0	7.7		

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